



PATENT  
Atty. Dkt. No. APPM/008245/DSM/BVCD/JP

*APR*  
*IPW*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:  
Wang et al.

Serial No.: 10/800,112

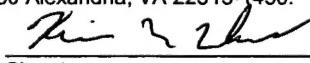
Confirmation No.: 8920

Filed: March 12, 2004

For: Method Of Depositing An  
Amorphous Carbon Film  
For Metal Etch Hardmask  
Application

MAIL STOP APPEAL BRIEF-PATENTS  
Commissioner for Patents  
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§ Group Art Unit: 1765  
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§ Examiner: Mahmoud Dahimene  
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CERTIFICATE OF MAILING 37 CFR 1.8	
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Dear Sir:

**APPEAL BRIEF**

Applicants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 1765 dated March 12, 2004, finally rejecting claims 1-22. The final rejection of claims 1-22 is appealed. This Appeal Brief is believed to be timely since mailed by the due date of September 5, 2006, as set by mailing a Notice of Appeal on July 5, 2006. Authorization to charge the fee of \$500.00 for filing this brief is provided on a separate fee transmittal. Please charge any additional fees that may be required to make this Appeal Brief timely and acceptable to Deposit Account No. 20-0782/APPM/008245/KMT.

09/12/2006 SSESHE1 0000027 200782 10800112

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## FEE TRANSMITTAL for FY 2006

Applicant claims small entity status. See 37 CFR 1.27

**TOTAL AMOUNT OF PAYMENT**

**(\$)** 500.00

Complete If Known	
Application Number	10/800,112
Filing Date	March 12, 2004
First Named Inventor	Wang et al.
Examiner Name	Mahmoud Dahimene
Art Unit	1765
Attorney Docket No.	APPM/008245/DSM/BVCD/JP

### METHOD OF PAYMENT (check all that apply)

Check  Credit Card  Money Order  None  Other (please identify) :  
 Deposit Account Deposit Account Number: 50-1074/008245/DSM/BCVD/JP Deposit Account Name: Applied Materials, Inc.

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

Charge fee(s) indicated below  Charge fee(s) indicated below, except for the filing fee  
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### FEE CALCULATION

#### 1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES	
	Fee (\$)	Fee (\$)	Fee (\$)	Fee (\$)	Fee (\$)	Fee (\$)
Utility	300	150	500	250	200	100
Design	200	100	100	50	130	65
Plant	200	100	300	150	160	80
Reissue	300	150	500	250	600	300
Provisional	200	100	0	0	0	0

#### 2. EXCESS CLAIM FEES

##### Fee Description

Each claim over 20 (including Reissues)

Each independent claim over 3 (including Reissues)

Multiple dependent claims

Total Claims	Extra Claims	Fee (\$)	Fee Paid (\$)	Small Entity	
				Fee (\$)	Fee (\$)
-20 or HP=	x	=		50	25
				200	100
				360	180

Multiple Dependent Claims	
Fee (\$)	Fee Paid (\$)

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims	Extra Claims	Fee (\$)	Fee Paid (\$)	Small Entity	
				Fee (\$)	Fee (\$)
- 3 or HP=	x	=			

HP = highest number of independent claims paid for, if greater than 3.

#### 3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
- 100 =	/ 50 =	(round up to a whole number) x		

#### 4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other (e.g., late filing surcharge) : APPEAL BRIEF FEE

500.00

### SUBMITTED BY

Signature		Registration No. (Attorney/Agent)	25,436	Telephone	713-623-4844
Name (Print/Type)	Robert W. Mulcahy			Date	September 5, 2006

This collection of information is required by 37 CFR 1.138. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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**Real Party in Interest**

The present application has been assigned to Applied Materials, Inc., 3050 Bowers Avenue, Santa Clara, California 95054.

### **Related Appeals and Interferences**

Applicants assert that no other appeals or interferences are known to the Applicants, the Applicants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

## **Status of Claims**

Claims 1-22 are pending in the application. Claims 1-22 were originally presented in the application. In an Office Action dated October 5, 2005, claims 1, 2, 7, 8, 9, 10, 16, 17, and 18 were rejected under 35 U.S.C. §102(e) as being anticipated by *Rui et al.* (U.S. Pat. App. Pub. No. 2004/0229470). Claims 3, 4, 5, 11, 12, and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Rui et al.* in view of *Liu et al.* (U.S. Pat. App. Pub. No. 2004/0038537). Claims 6 and 14 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Rui et al.* in view of *Liu et al.*, and further in view of *Lee et al.* (U.S. Patent No. 6,043,167). Claims 15, 19, 20, and 21 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Rui et al.* in view of *Liu et al.*, and further in view of *Dakshina-Murthy et al.* (U.S. Patent No. 6,884,733). Claim 22 was rejected under 35 U.S.C. §103(a) as being unpatentable over *Rui et al.* in view of *Liu et al.*, in view of *Dakshina-Murthy et al.*, and further in view of *Lee et al.* In response to the Office Action dated October 5, 2005, claims 2, 3, 4-6, 9, 11-14, 16, 19-20, and 22 were amended.

In a Final Office Action dated April 5, 2006, claims 1-22 were rejected. Claims 1, 3-9, and 11-18 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Dakshina-Murthy et al.* in view of *Yang et al.* (U.S. Pat. App. Pub. No. 2003/0003771). Claims 2, 10, and 19-22 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Dakshina-Murthy et al.* in view of *Yang et al.* and further in view of *Park et al.* (U.S. Pat. App. Pub. No. 2004/0224241). In response to the Final Office Action dated April 5, 2006, Applicants proposed amending claims 1 and 9 and cancelling claims 2 and 10. A Notice of Appeal was filed July 5, 2006. In an Advisory Action dated July 25, 2006, the Examiner indicated that the proposed amendments would not be entered and that claims 1-22 were still rejected.

Claims 1-22 stand finally rejected as discussed below. The final rejections of claims 1-22 are appealed. The pending claims are shown in the attached Claims Appendix.

### **Status of Amendments**

In response to the Final Office Action dated April 5, 2006, Applicants proposed amending claims 1 and 9 and cancelling claims 2 and 10. The Examiner responded to Applicants' response in an Advisory Action dated July 25, 2006. In the Advisory Action, the Examiner indicated that the proposed amendments would not be entered.

## Summary of Claimed Subject Matter

Claimed embodiments of the invention provide a method for etching conductive materials with amorphous carbon materials disposed thereon with minimal or reduced defect formation. (See, for example, Paragraphs [0010] & [0017]).

In the embodiments of independent claim 1, a method for processing a substrate in a processing chamber is provided. (See, for example, Paragraph [0010]). The method includes forming a conductive material layer 110 on the surface of the substrate 105. (See, for example, Paragraph [0010], Figure 1A). The method further includes depositing an amorphous carbon layer 130 on the conductive material layer 110 by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10 (See, for example, Paragraph [0020]), and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source. (See, for example, Paragraph [0024]). The method further includes etching the amorphous carbon layer to form a patterned amorphous carbon layer. (See, for example, Paragraphs [0010] and [0049], Figure 1B). The method further includes etching feature definitions in the conductive material layer corresponding to the patterned amorphous carbon layer. (See, for example, Paragraphs [0010] and [0050], Figure 1C).

In the embodiments of independent claim 9, a method for processing a substrate in a chamber is provided. (See, for example, Paragraph [0011]). The method includes forming a conductive material layer 110 on a surface of a substrate 105. (See, for example, Paragraph [0011]). The method further includes depositing an amorphous carbon hardmask 130 on the conductive material layer 110 by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10 (See, for example, Paragraph [0020]), and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source. (See, for example, Paragraph [0024]). The method further includes depositing an anti-reflective

coating 140 on the amorphous carbon hardmask 130 (See, for example, Paragraphs [0042] and [0045], Figure 1A), depositing a patterned resist material 150 on the anti-reflective coating 140 (See, for example, Paragraphs [0048], Figure 1A), etching the anti-reflective coating 140 and amorphous carbon hardmask 130 to the conductive material layer, and etching feature definitions in the conductive material layer. (See, for example, Paragraphs [0011] and [0049]-[0050], Figures 1B-1C).

In the embodiments of independent claim 19, a method for processing a substrate in a chamber is provided. (See, for example, Paragraph [0012]). The method includes forming an aluminum-containing layer on a surface of the substrate. (See, for example, Paragraphs [0012] and [0019]). The method further includes depositing an amorphous carbon hardmask on the aluminum-containing layer by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10 (See, for example, Paragraph [0020]), and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source. (See, for example, Paragraph [0024]). The method further includes depositing an anti-reflective coating 140 on the amorphous carbon hardmask 130, wherein the anti-reflective coating 140 is a material selected from the group of silicon nitride, silicon carbide, carbon-doped silicon oxide, amorphous carbon, and combinations thereof (See, for example, Paragraphs [0012] and [0045]), depositing a patterned resist material 150 on the anti-reflective coating 140 (See, for example, Paragraph [0048], Figure 1A), etching the anti-reflective coating 140 and amorphous carbon hardmask 130 to the aluminum-containing layer (See, for example, Paragraph [0012]), removing the resist material (See, for example, Paragraphs [0012] and [0049]), etching feature definitions in the aluminum-containing layer at an etch selectivity of amorphous carbon to the aluminum-containing between about 1:3 and about 1:10 (See, for example, Paragraph [0012]), and removing the one or more amorphous carbon layers by exposing the one or more amorphous carbon layers to a plasma of a hydrogen-containing gas or an oxygen-containing gas (See, for example, Paragraphs [0012] and [0051], Figure 1D).

**Grounds of Rejection to be Reviewed on Appeal**

1. Claims 1, 3-9, and 11-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Dakshina-Murthy et al.* in view of *Yang et al.*
2. Claims 2, 10, and 19-22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Dakshina-Murthy et al.* in view of *Yang et al.* and further in view of *Park et al.*

## ARGUMENTS

### **A. OBVIOUSNESS OF CLAIMS 1, 3-9, AND 11-18 OVER DAKSHINA-MURTHY ET AL. IN VIEW OF YANG, ET AL.**

Claims 1, 3-9, and 11-18 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Dakshina-Murthy et al.* (U.S. Patent No. 6,884,733) in view of *Yang et al.* (U.S. Pat. App. Pub. No. 2003/0003771).

In the Final Office Action dated April 5, 2006, the Examiner states that a difference between Applicants' claim 1 and the reference *Dakshina-Murthy* is that *Dakshina-Murthy* fails to disclose a dual-frequency plasma for the PECVD deposition. The Examiner further states that the reference of *Yang et al.* describes a process where a dual-frequency plasma is used for deposition of an amorphous carbon layer using C<sub>2</sub>H<sub>4</sub> or C<sub>2</sub>H<sub>6</sub> gases. The Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the process of *Dakshina-Murthy* to use the dual-frequency method of *Yang et al.* for forming the amorphous carbon layer because *Yang et al.* teaches dual-frequency is conventionally used for amorphous carbon deposition. The Examiner further concludes that one of ordinary skill in the art would have been motivated to use a dual-frequency deposition method in order to obtain a high-quality dense deposit yielding a compact structure (as taught by *Yang*, page 2, paragraph 0016) which is desirable for a masking layer to minimize erosion during the subsequent conductive etch step.

Applicants respectfully traverse this rejection based on the grounds that the Examiner has not established a case of *prima facie* obviousness. The Examiner bears the initial burden of establishing a *prima facie* case of obviousness. See MPEP § 2142. To establish a *prima facie* case of obviousness three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Third, the prior art reference (or references when combined)

must teach or suggest all the claim limitations. See MPEP § 2143. The present rejection fails to establish at least the first element.

*Dakshina-Murthy et al.* discloses depositing an amorphous carbon mask on a doped polysilicon material, and then depositing an anti-reflective cap layer on the amorphous carbon layer. Col. 3: lines 17-24. *Dakshina-Murthy et al.* discloses that the amorphous carbon layer is deposited in a PECVD chamber using a hydrocarbon atmosphere such as ethylene, propylene, methane, and the like. Col. 5: lines 46-48. *Dakshina-Murthy et al.* further discloses that the PECVD process is performed with a plasma power of between approximately 800 and 1500 Watts. Col. 5: lines 50-53. *Dakshina-Murthy et al.* does not teach, show, or suggest the use of dual frequency RF for depositing an amorphous carbon layer.

*Yang et al.* discloses providing a thin layer of an adhesion promoter material, such as relatively hydrogen-free hydrogenated silicon carbon (SiC:H), between layers of silicon nitride (Si<sub>3</sub>N<sub>4</sub>) and an amorphous fluorocarbon (a-F:C) to enhance the adhesion and mechanical properties of the damascene structure. See U.S. Pat App. Pub. No. 2003/0003771 at [0001]. *Yang et al.* discloses depositing the fluorinated amorphous carbon (a-F:C) layer on a substrate by providing a fluorine containing gas, preferably octafluorocyclobutane, and a carbon containing gas, preferably methane. See U.S. Pat App. Pub. No. 2003/0003771 at [0016]. *Yang et al.* further discloses that the power supplied during this deposition step typically involves a dual frequency RF discharge. See U.S. Pat App. Pub. No. 2003/0003771 at [0040]. Thus, *Yang et al.* teaches the use of a dual frequency RF when depositing an amorphous fluorocarbon on a dielectric layer.

Furthermore, the Examiner's statement that *Yang et al.* at page 2, paragraph [0016] teaches the use of a dual-frequency deposition method in order to obtain a high quality dense deposit yielding a compact structure fails to provide motivation for the use of a dual frequency RF when depositing an amorphous carbon layer on a conductive material layer. Paragraph [0016] cited by the Examiner actually refers to the use of dual frequency RF when depositing a SiC layer, not an amorphous carbon layer. Page 2, paragraph [0016] of *Yang et al.* states that "[t]he conditions of the deposition result in a deposited silicon carbide layer that has relatively few silicon-hydrogen bonds thereby

yielding a *compact structure* which promotes adhesion of the damascene structure layers to one another and which reduces diffusion of fluorine through the silicon carbide layer." Thus the passage referring to "a compact structure" refers to the adhesion promoting silicon carbide layer, and is not relevant to modifying the deposition of the fluorinated amorphous carbon layer.

Therefore, *Dakshina-Murthy et al.* and *Yang et al.*, either alone or in combination do not teach, show, motivate or suggest a method for processing a substrate in a processing chamber, comprising forming a conductive material layer on a surface of the substrate, depositing an amorphous carbon layer on the conductive material layer by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10, and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source, etching the amorphous carbon layer to form a patterned amorphous carbon layer, and etching feature definitions in the conductive material layer corresponding to the patterned amorphous carbon layer as recited in independent claim 1 and claims 2-8 dependant thereon. Withdrawal of the rejection is respectfully requested.

Also, *Dakshina-Murthy et al.* and *Yang et al.*, either alone or in combination fail to teach, motivate or suggest a method for processing a substrate in a chamber, comprising forming a conductive material layer on a surface of the substrate, depositing an amorphous carbon hardmask on the conductive material layer by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10, and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source, depositing an anti-reflective coating on the amorphous carbon hardmask, depositing a patterned resist material on the anti-reflective coating, etching the anti-reflective coating and amorphous carbon hardmask to the conductive material layer, and etching feature definitions in the conductive material layer as recited in claim 9 and claims 10-18 dependent thereon. Withdrawal of the rejection is respectfully requested.

**B. OBVIOUSNESS OF CLAIMS 2, 10, AND 19-22 OVER DAKSHINA-MURTHY ET AL. IN VIEW OF YANG ET AL. AND FURTHER IN VIEW OF PARK ET AL.**

Claims 2, 10, and 19-22 are rejected under 35 U.S.C. § 103(a) as being unpatentable over *Dakshina-Murthy et al.* in view of *Yang et al.* and further in view of *Park et al.* (U.S. Pat. App. Pub. No. 2004/0224241).

The Examiner states that *Dakshina-Murthy et al.* fails to disclose an aluminum or aluminum alloy for the conductive gate material. The Examiner states that *Park et al.* discloses aluminum alloys are conventionally used as gate conductors. The Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of *Dakshina-Murthy et al.* to use the aluminum alloy gate conductor of *Park et al.* because *Park et al.* discloses aluminum alloys are conventionally used as gate conductors. The Examiner further concludes that one of ordinary skill in the art would have been motivated to use an aluminum alloy as the gate conductor instead of polysilicon in order to reduce signal delay due to the low resistivity of the material. The Examiner states that the amorphous carbon layer will still be used as a mask.

In addition to the teachings discussed above, *Dakshina-Murthy et al.* further discloses that conventional processes typically utilize polysilicon based gate conductors because metal gate conductors are difficult to etch, are less compatible with front-end processing, and have relatively low melting points. Col 1: lines 65-67; Col. 2: lines 1-2.

The teachings of *Yang et al.* are discussed above.

*Park et al.* discloses gate lines as well as a gate shorting bar including two films having different physical characteristics, a lower film and an upper film. See U.S. Pat. App. Pub. No. 2004/0224241 at [0069]. The upper film is preferably made of a low resistivity metal including Al containing metal such as Al and Al alloy for reducing signal delay or voltage drop in the gate lines. See U.S. Pat. App. Pub. No. 2004/0224241 at [0069]. On the other hand, the lower film is preferably made of material such as Cr, Mo, Mo alloy, Ta and Ti, which has good physical, chemical, and electrical contact characteristics with other oxide materials such as indium tin oxide (ITO) and indium zinc oxide (IZO). See U.S. Pat. App. Pub. No. 2004/0224241 at [0069].

The arguments discussed above regarding *Dakshina-Murthy et al.* and *Yang et al.* are equally applicable here. As a result, *Dakshina-Murthy et al.* and *Yang et al.* in view of *Park et al.*, either alone or in combination do not teach, show, motivate or suggest a method for processing a substrate in a chamber, comprising forming an aluminum-containing layer on a surface of the substrate, depositing an amorphous carbon hardmask on the aluminum-containing layer by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10, and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source, depositing an anti-reflective coating on the amorphous carbon hardmask, wherein the anti-reflective coating is a material selected from the group of silicon nitride, silicon carbide, carbon-doped silicon oxide, amorphous carbon, and combinations thereof, depositing a patterned resist material on the anti-reflective coating, etching the anti-reflective coating and amorphous carbon hardmask to the aluminum-containing layer, removing the resist material, etching feature definitions in the aluminum-containing layer at an etch selectivity of amorphous carbon to the aluminum-containing between about 1:3 and about 1:10, and removing the one or more amorphous carbon layers by exposing the one or more amorphous carbon layers to a plasma of a hydrogen-containing gas or an oxygen-containing gas as recited in claim 19 and claims 20-22 dependent thereon. Withdrawal of the rejection is respectfully requested.

Further, *Dakshina-Murthy et al.* and *Yang et al.* in view of *Park et al.*, either alone or in combination do not teach, show, motivate or suggest a method for processing a substrate in a processing chamber, comprising forming a conductive material layer on a surface of the substrate, depositing an amorphous carbon layer on the conductive material layer by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10, and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source, etching the amorphous carbon layer to form a patterned amorphous carbon layer, and etching feature definitions in the conductive material layer corresponding to the patterned

amorphous carbon layer as recited in independent claim 1 and claim 2 dependant thereon. Withdrawal of the rejection is respectfully requested.

Also, *Dakshina-Murthy et al.* and *Yang et al.* in view of *Park et al.*, either alone or in combination do not teach, show, motivate or suggest a method for processing a substrate in a chamber, comprising forming a conductive material layer on a surface of the substrate, depositing an amorphous carbon hardmask on the conductive material layer by a method comprising introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10, and generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source, depositing an anti-reflective coating on the amorphous carbon hardmask, depositing a patterned resist material on the anti-reflective coating, etching the anti-reflective coating and amorphous carbon hardmask to the conductive material layer, and etching feature definitions in the conductive material layer as recited in claim 9 and claim 10 dependent thereon. Withdrawal of the rejection is respectfully requested.

## CONCLUSION

For the reasons stated above, Applicants respectfully submit that the rejection of claims 1-22 under §103(a) is improper. Reversal of the rejection of claims 1-22 is respectfully requested.

Respectfully submitted,



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## CLAIMS APPENDIX

1. (Previously Presented) A method for processing a substrate in a processing chamber, comprising:

forming a conductive material layer on a surface of the substrate;

depositing an amorphous carbon layer on the conductive material layer by a method comprising:

introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10; and

generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source;

etching the amorphous carbon layer to form a patterned amorphous carbon layer; and

etching feature definitions in the conductive material layer corresponding to the patterned amorphous carbon layer.

2. (Original) The method of claim 1, wherein the conductive material is selected from the group of aluminum or aluminum alloy.

3. (Previously Presented) The method of claim 6, wherein the first frequency is provided at a power between 200 watts and 800 watts and the second frequency is provided at a power between about 1 watt and about 200 watts.

4. (Previously Presented) The method of claim 1, wherein the one or more hydrocarbon compounds are selected from the group consisting of propylene ( $C_3H_6$ ), propyne ( $C_3H_4$ ), propane ( $C_3H_8$ ), butane ( $C_4H_{10}$ ), butylene ( $C_4H_8$ ), butadiene ( $C_4H_6$ ), acetylene ( $C_2H_2$ ), and combinations thereof.

5. (Previously Presented) The method of claim 1, further comprising introducing an inert gas with the one or more hydrocarbons into the processing chamber.

6. (Previously Presented) The method of claim 1, wherein the dual-frequency RF source comprises providing a first frequency between about 10 MHz and about 30 MHz and a second frequency between about 100 KHz and about 500 KHz.

7. (Original) The method of claim 1, wherein the etch selectivity of amorphous carbon to the conductive material is between about 1:3 and about 1:10.

8. (Original) The method of claim 1, wherein the amorphous carbon layer comprises an anti-reflective coating.

9. (Previously Presented) A method for processing a substrate in a chamber, comprising:

forming a conductive material layer on a surface of the substrate;

depositing an amorphous carbon hardmask on the conductive material layer by a method comprising:

introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10; and

generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source;

depositing an anti-reflective coating on the amorphous carbon hardmask;

depositing a patterned resist material on the anti-reflective coating;

etching the anti-reflective coating and amorphous carbon hardmask to the conductive material layer; and

etching feature definitions in the conductive material layer.

10. (Original) The method of claim 9, wherein the conductive material is selected from the group of aluminum or aluminum alloy.

11. (Previously Presented) The method of claim 14, wherein the first frequency is provided at a power between 200 watts and 800 watts and the second frequency is provided at a power between about 1 watt and about 200 watts.

12. (Previously Presented) The method of claim 9, wherein the one or more hydrocarbon compounds are selected from the group consisting of propylene (C<sub>3</sub>H<sub>6</sub>), propyne (C<sub>3</sub>H<sub>4</sub>), propane (C<sub>3</sub>H<sub>8</sub>), butane (C<sub>4</sub>H<sub>10</sub>), butylene (C<sub>4</sub>H<sub>8</sub>), butadiene (C<sub>4</sub>H<sub>6</sub>), acetylene (C<sub>2</sub>H<sub>2</sub>), and combinations thereof.

13. (Previously Presented) The method of claim 9, further comprising introducing an inert gas with the one or more hydrocarbons into the processing chamber.

14. (Previously Presented) The method of claim 9, wherein the dual-frequency RF source comprises providing a first frequency between about 10 MHz and about 30 MHz and a second frequency between about 100 KHz and about 500 KHz.

15. (Original) The method of claim 9, wherein the anti-reflective coating is a material selected from the group of silicon nitride, silicon carbide, carbon-doped silicon oxide, amorphous carbon, and combinations thereof.

16. (Previously Presented) The method of claim 9, further comprising depositing a barrier layer prior to depositing the conductive material layer.

17. (Previously Presented) The method of claim 9, further comprising removing the resist material prior to etching feature definitions in the conductive material layer.

18. (Original) The method of claim 9, wherein the etch selectivity of amorphous carbon to the conductive material is between about 1:3 and about 1:10.

19. (Previously Presented) A method for processing a substrate in a chamber, comprising:

forming an aluminum-containing layer on a surface of the substrate;  
depositing an amorphous carbon hardmask on the aluminum-containing layer by a method comprising:

introducing into the processing chamber one or more hydrocarbon compounds having the general formula  $C_xH_y$ , wherein x has a range of 2 to 4 and y has a range of 2 to 10; and

generating a plasma of the one or more hydrocarbon compounds by applying power from a dual-frequency RF source;

depositing an anti-reflective coating on the amorphous carbon hardmask, wherein the anti-reflective coating is a material selected from the group of silicon nitride, silicon carbide, carbon-doped silicon oxide, amorphous carbon, and combinations thereof;

depositing a patterned resist material on the anti-reflective coating;

etching the anti-reflective coating and amorphous carbon hardmask to the aluminum-containing layer;

removing the resist material;

etching feature definitions in the aluminum-containing layer at an etch selectivity of amorphous carbon to the aluminum-containing between about 1:3 and about 1:10; and

removing the one or more amorphous carbon layers by exposing the one or more amorphous carbon layers to a plasma of a hydrogen-containing gas or an oxygen-containing gas.

20. (Previously Presented) The method of claim 19, wherein the one or more hydrocarbon compounds are selected from the group consisting of propylene ( $C_3H_6$ ), propyne ( $C_3H_4$ ), propane ( $C_3H_8$ ), butane ( $C_4H_{10}$ ), butylene ( $C_4H_8$ ), butadiene ( $C_4H_6$ ), acetylene e ( $C_2H_2$ ), and combinations thereof.

21. (Original) The method of claim 19, further comprising introducing an inert gas with the one or more hydrocarbons into the processing chamber.

22. (Previously Presented) The method of claim 19, wherein the generating a plasma comprises applying power from a dual-frequency RF source comprises providing a first frequency between about 10 MHz and about 30 MHz at a power between 200 watts and 800 watts and a second frequency between about 100 KHz and about 500 KHz at a power between about 1 watt and about 200 watts.

## **EVIDENCE APPENDIX**

No evidence is submitted by Applicants.

## **RELATED PROCEEDINGS APPENDIX**

No copies of decisions rendered by a court or the Board are included because as stated on page 4, Applicants assert that no other appeals or interferences are known to the Applicants, the Applicants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.